Ohio Agricultural Experiment Station

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PLANS AND SUMMARY TABLES

OF THE EXPERIMENTS AT THE CENTRAL FARM, WOOSTER AND THE NORTHEASTERN TEST FARM, STRONGSVILLE

ON THE

MAINTENANCE OF SOIL FERTILITY

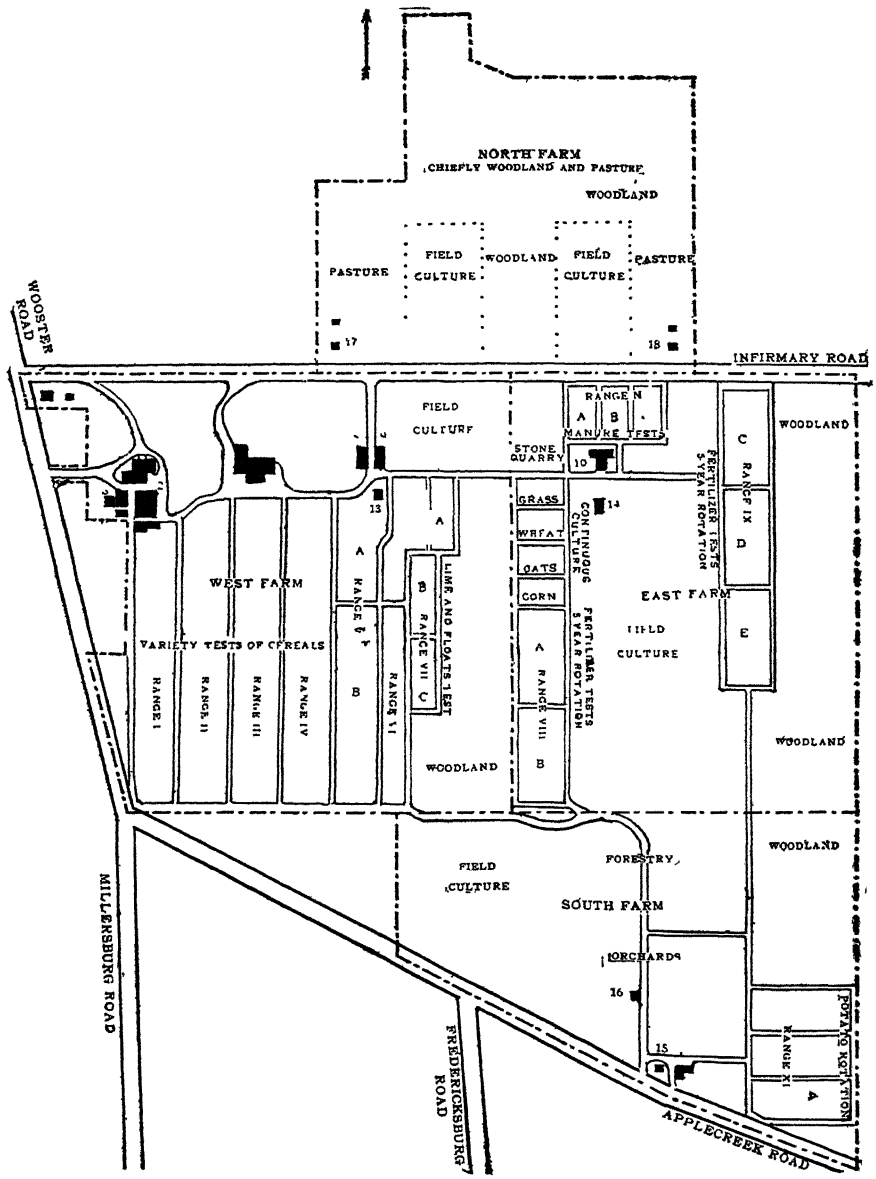
ARRANGED FOR REFERENCE IN THE FIELD

ANNOUNCEMENT

The experiments reported in the following pages were begun in 1893, immediately after the removal of the Experiment Station to Wayne county. The general plan of this work and the results obtained up to that time are published in Bulletin 110, issued in December, 1899, (now out of print) and again in Bulletins 182, 183, and 184, reporting to the end of 1906. It now seems desirable to follow these general publications with an annual statement, giving as briefly as possible the new data obtained from each successive crop, and referring the reader to Bulletins 182 and 183 for more complete information respecting the nature of the soils under experiment and the general plan of the work, and to Bulletin 184 for the statistics of crop yields for the years 1894 to 1906, inclusive.

The results at Wooster for 1907 are given in Circular No. 83, those for 1908 in Circular No. 92, those for 1909 in Circular No. 104, those for 1910 in Circular No. 114, those for 1911 in Circular No. 120. and those for 1912 in the present circular.

The results at Strongsville are given in Bulletins 182 and 184 for the earlier years of the work, those for the years 1906 to 1911 inclusive in Bulletin 260, those for 1912 in the present circular.



The central farm, near Wooster

THE WOOSTER EXPERIMENTS

FERTILIZFRS AND MANURE ON CROPS GROWN CONTINUOUSLY ON THE SAME LAND

Wheat, oats and corn, one acre (10 plots) each, have been grown in this experiment since 1894. The fertilizers are applied to Plots 2 and 8 in arbitrary quantities, while on Plots 3 and 9 the three fertilizing elements, nitrogen, phosphorus and potassium, are given in approximately the same ratio to each other in which they are found in the plant.

The applications to Plots 2 and 8 have in every case produced larger average yields than those to Plots 3 and 9, but this may in part be accounted for by the combined nitrogen which is carried to the soil in rain, thus enabling the crops grown on 2 and 8 to utilize larger quantities of the phosphorus and potassium given in the fertilizer than that required merely to balance the fertilizer nitrogen.

The manure applications on Plots 5 and 6 were intended to carry nitrogen in quantities equivalent to the applications on Plots 2 and 3 on the one hand and 8 and 9 on the other, estimating the manure to carry 10 pounds of nitrogen per ton, but actual analyses of manure made during recent years indicate that this estimate was too high for open yard manure, such as is used in these tests. The average application of phosphorus and potassium in the manure closely approximates the average given to the four fertilized plots.

In this test the corn and wheat show a rapid falling off in yield on the unfertilized land during recent years. The oats also show a reduction in yield, but not so great as that of the other crops.

It is much more difficult to control the weed growth in the wheat and oats grown continuously than where the same crops are grown in rotation, and it was necessary a few years ago to divide these tracks and fallow the two ends in alternate seasons in order to destroy the weeds. Latterly the entire plots have been cropped again.

Diagram I shows the arrangement of plots and plan of fertilizing in this experiment, and the general outcome is shown in Tables I and II, which give the yields by periods.

DIAGRAM I: PLAN OF FERTILIZING IN CONTINUOUS CULTURE

PLOTS ONE-TENTH ACRE

	Fertilizing materials in pounds per acre
Wheat	1 None
	2 Acid phos , 160; muriate potash, 100; nitrate soda, 120; dried blood, 50*
	3 Acid phos., 45; muriate potash, 30; nitrate soda, 120; dried blood, 50*
	4 None
	5 Yard manure, 2½ tons
	6 Yard manure, 5 tons
	7 None
	8 Acid phos., 160; muriate potash, 100; nitrate of soda, 280; dried blood, 50**
	9 Acid phos., 90; muriate potash, 60; nitrate of soda, 280; dried blood, 50**
	10 None
Oats	1 None
	2 Acid phos., 160; muriate potash, 100; nitrate soda, 160
	3 Acid phos., 55; muriate potash, 50; nitrate soda, 160
	4 None
	5 Yard manure, 2½ tons
	6 Yard manure, 5 tons
	7 None
	8 Acid phos., 160; muriate potash, 100; nitrate soda, 320
	9 Acid phos., 110; muriate potash, 100; nitrate soda, 320
	10 None
Corn	1 None
	2 Acid phos., 160; muriate potash, 100; nitrate soda, 160
	3 Acid phos., 60; muriate potash, 30; nitrate soda, 160
	4 None
	5 Yard manure, 2½ tons
	6 Yard manure, 5 tons
	7 None
	8 Acid phos., 160; muriate potash, 100; nitrate soda, 320
	9 Acid phos., 120; muriate potash, 60; nitrate soda, 320
	10 None
	(South)

*120 pounds nitrate of soda plus 50 pounds dried blood is equivalent to 160 pounds nitrate of soda.
**280 pounds nitrate of soda plus 50 pounds dried blood is equivalent to 320 pounds nitrate of soda.

TABLE I: CROPS GROWN IN CONTINUOUS CULTURE. Yield and increase for 1912 and average annual yield for 19 years 1894-1912

Plot No.	Fertilizing materials (Pounds per acre)	1912 Yield Grain Bus.	1912 Yield Stover or straw Lbs.	1912 Increase Grain Bus.	1912 Increase Stover or straw Lbs.	19 years, 1894-1912 Yield Grain Bus.	19 years, 1894-1912 Yield Stover or straw Lbs.	19 years, 1894-1912 Increase Grain Bus.	19 years, 1894-1912 Increase Stover or straw Lbs.	Plot No.
	Corn									
1	None	17.04	1,360	.....	.....	21.25	1,439	.....	.....	1
2	Acid phosphate, 160; muriate potash, 100; nitrate soda, 160	43.82	2,620	29.74	1,317	42.09	2,346	22.65	972	2
3	" " 60; " " 30; " " 160	30.21	2,070	19.10	823	33.70	1,956	16.08	645	3
4	None	8.15	1,190	.....	.....	15.80	1,246	.....	.....	4
5	Yard manure, 2½ tons	22.71	1,910	13.92	713	27.67	1,781	12.21	547	5
6	" " 5 "	34.53	2,340	25.10	1,137	37.64	2,154	22.51	933	6
7	None	10.07	1,210	.....	.....	14.77	1,210	.....	.....	7
8	Acid phosphate, 160; muriate potash, 100; nitrate soda, 320	52.82	2,800	44.49	1,727	47.24	2,431	33.50	1,282	8
9	" " 120; " " 60; " " 320	47.97	2,570	41.38	1,633	44.50	2,286	31.78	1,194	9
10	None	4.85	800	.....	.....	11.68	1,026	.....	.....	10
	Average unfertilized yield	10.03	1,140	.....	.....	15.88	1,245	.....	.....	
	Oats									
1	None	26.95	1,117	.....	.....	20.29	790	.....	.....	1
3	Acid phosphate, 160; muriate potash, 100; nitrate soda, 160	62.89	3,077	32.74	1,856	41.41	1,949	20.31	1,124	2
3	" " 55; " " 50; " " 160	53.28	1,885	19.92	459	37.53	1,652	15.64	787	3
4	None	36.54	1,430	.....	.....	22.70	894	.....	.....	4
5	Yard manure, 2½ tons	49.30	2,072	8.23	605	30.80	1,274	7.65	347	5
6	" " 5 "	60.30	2,720	15.13	1,215	38.29	1,821	14.71	862	6
7	None	37.73	1,542	.....	.....	23.41	992	.....	.....	7
8	Acid phosphate, 160; muriate potash, 100; nitrate soda, 320	66.00	3,292	28.38	1,797	47 39	2,497	23.77	1,506	8
9	" " 110; " " 100; " " 320	62.65	2,915	26.79	1,466	45.61	2,354	21.19	1,363	9
10	None	34.92	1,402	.....	.....	24.20	990	.....	.....	10
	Average unfertilized yield	34.04	1,373	.....	.....	22.92	921	.....	.....	
	Wheat									
1	None	.58	325	....	.....	7.42	1,051	.....	.....	1
1	Acid phos., 160; mur. potash, 100; nit. soda, 120; dried blood, 50	2.46	1,305	1.67	973	19.05	2,474	11.48	1,458	2
3	" " 45; " " 30; " " 120; " " 50	1.67	740	.67	402	15.00	1,831	7.26	850	3
4	None	1.21	345	....	.....	7.89	945	.....	.....	4
5	Yard manure, 2½ tons	1.12	862	.05	546	13.33	1,699	5.47	744	5
6	" " 5 "	2.62	1,202	1.69	916	17.41	2,212	9.59	1,250	6
7	None	.79	257	....	.....	7.79	969	.....	.....	7
8	Acid phos., 160; mur. potash, 100; nit. soda, 280; dried blood, 50	3.37	1,470	2.51	1,215	21.96	2,858	14.45	1,931	8
9	" " 90; " " 60; " " 280; " " 50	3.41	1,207	2.48	955	19 92	2,421	12.69	1,549	9
10	None	1.00	250	....	....	6.96	840	.....	.....	10
	Average unfertilized yield	.89	294	....	.....	7.52	938	.....	.....	

The unfertilized yield on plot 1 in the corn test is regularly higher than on the similarly treated plots, 4, 7 and 10, The difference in 1911 was somewhat larger than usual, and the average yields on all the corn plots for that year are higher than the average for the previous 5-year period or for the year 1912. The oats crop for this year shows yields considerably above the average, due to favorable weather conditions. The wheat crop of 1911 suffered from a combined attack of Hessian fly and joint worm, and that of 1912 from Hessian fly and severe winter conditions.

TABLE II: CROPS GROWN IN CONTINUOUS CULTURE. Average annual yield and increase per acre by 5-year periods

Plot No.	Grain						Stover or straw						Plot No.
	1894-1898		1899-1903		1904-1908		1894-1898		1899-1903		1904-1908		
	Yield Bus.	Increase Bus.	Yield Bus.	Increase Bus.	Yield Bus.	Increase Bus.	Yield Lbs.	Increase Lbs.	Yield Lbs.	Increase Lbs.	Yield Lbs.	Increase Lbs.	
Corn													
1	29.19	.....	21.85	.....	17 09	.....	1,449	.....	1,234	.....	1,546	.....	1
2	44.61	15.53	47.21	27.03	38.50	24 08	2,076	630	2,202	1,013	2,520	1,394	2
3	38.86	9.88	39.09	20.59	28 00	16.25	1,770	330	1,820	671	2,138	848	3
4	28.86	.....	16.81	.....	9.09	.....	1,436	.....	1,106	.....	1,162	.....	4
5	36.44	8.68	29.21	12.75	23.77	14.75	1,670	278	1,588	497	1,958	773	5
6	43.13	16.49	40.11	24.01	34.62	25.65	1,938	590	1,924	851	2,404	1,195	6
7	25.53	.....	15.74	.....	8.86	.....	1,304	.....	1 060	.....	1,232	.....	7
8	44.43	20.26	52.55	37 85	44.55	36.41	2,008	749	2,376	1,358	2,568	1,415	8
9	42.76	19.96	50.13	36.45	41.73	34.34	1,870	655	2,232	1,256	2,458	1,383	9
10	21.44	.....	12.65	.....	6.64	.....	1,170	.....	934	.....	996	.....	10
	26.26	.....	16.76	.....	10.43	.....	1,339	.....	1,083	.....	1,231	.....	
Oats													
1	26.87	.....	16.75	.....	20.40	.....	892	....	578	.....	855	.....	1
2	42.22	14.75	40.11	22.39	45.46	24 59	1,697	749	1,701	1,083	2,136	1,279	2
3	38.75	10.67	36.47	17.78	40.79	19.46	1,470	467	1,463	806	1,890	1,037	3
4	28.67	.....	19.66	.....	21.80	.....	1,059	....	697	.....	855	.....	4
5	30.83	2.40	28.51	8.13	35.03	12.98	1,021	—55	1,030	283	1,565	670	5
6	34.81	6.63	36.76	15.67	44.10	21.83	1,265	173	1,516	720	2,232	1,297	6
7	27.94	.....	21.82	.....	22.55	.....	1,110	.....	846	.....	974	.....	7
8	48.75	20.37	48.87	26.51	47.89	25.17	2,086	971	2,342	1,493	2,675	1,712	8
9	46.94	18.10	47.36	24.46	45.61	22.80	1,982	862	2,131	1.078	2,548	1,601	9
10	29.28	....	23.43	.....	22.98	.....	1,125	.....	856	.....	936	.....	10
	28.19	.....	20.41	.....	21.93	.....	1,046	.....	744	.....	905	.....	
Wheat													
1	10.56	.....	7.86	.....	5.95	.....	1,334	.....	926	.....	1,038	.....	1
2	19.78	9.32	21.90	13.73	17.41	11.21	2,205	967	2,420	1,489	2,701	1,684	2
3	16.33	5.97	16.90	8.42	13.31	6.87	2,720	579	1,644	709	2,158	1,163	3
4	10.26	.....	8.78	.....	6.68	.....	1,044	.....	940	.....	973	.....	4
5	13.28	3.13	14.26	5.28	12.23	5.74	1,475	430	1,498	550	1,973	932	5
6	15.77	5.72	18.46	9.28	17.48	11.18	1,743	698	2,014	1,057	2,670	1,663	6
7	9.95	.....	9.38	.....	6.11	.....	1,045	.....	965	.....	1,025	.....	7
8	20.69	10.87	25.26	16.47	20.88	14.80	2,510	1,463	2,724	1,810	3,208	2,239	8
9	19.01	9.33	22.45	14.25	19.12	13.10	2,159	1,110	2,181	1,323	2,846	1,933	9
10	9.55	.....	7.62	.....	6.00	.....	1,051	.....	805	.....	858	.....	10
	10.08	.....	8.41	.....	6.19	.....	1,119	.....	909	.....	973	.....	

THE 5-YEAR ROTATION

In this experiment corn, oats, wheat, clover and timothy are grown in succession on five tracts of land, sections A, B, C, D and E, containing 30 one-tenth acre plots each. Sections A and B of this test lie in range VIII, south of the areas devoted to continuous cropping, while sections C, D and E occupy Range IX, near the east side of the farm.

The land was underdrained in 1893 and corn was grown that season on section C. The planting was delayed by the draining and the season proved unfavorable, so that the results of that season's work have not been included in the average. In 1894 wheat was harvested on section A. oats on section C and corn on section D. The clover and timothy followed the wheat on section A in 1895 and 1896, and the rotation has since been regularly followed.

Beginning with 1900, lime was applied to the west half of each plot in this rotation, fertilized and unfertilized alike, while the land was being prepared for corn, the lime being applied at the rate of one ton per acre of ground quicklime in 1900, 1901, 1902 and 1903, applied in the spring after plowing, and in the fall of 1903 for the crop of 1904. In 1905 the liming was changed to the east half, a ton of quicklime being used that spring, but in 1906 and 1907 ground limestone was used, at the rate of two tons per acre. No lime was applied in 1908, but since then it has been applied to the west half as at the beginning. The table gives the average yield for the entire plot in each case, averaging the limed and unlimed halves.

In 1895 and 1896, and again in 1899, 1900 and 1901 the wheat in this test was injured by Hessian fly, the yield on the unfertilized land falling to a small fraction over one bushel per acre in 1896 and 1900. The wheat was again injured by Hessian fly in 1911, and also by joint worm. In 1912 these pests again prevailed, and in addition the winter conditions were such as to cause a partial to complete destruction of the wheat crop over the major portion of the State, the level lands of western Ohio suffering the most severely. The corn in this experiment was severely injured by white grubs in 1910, and in 1912 the injury was so great that no comparisons could be made.

The clover seeding failed to catch in 1904 and soybeans were grown instead and harvested as hay, the timothy crop of the following year being replaced by German millet. The timothy failed in 1909, as did the millet sown in its place, so that no crop of either was harvested that year.

Diagram II shows the arrangement of plots and plan of fertilizing one of the sections in this experiment, the five sections being arranged and treated exactly alike. Tabies III and IV give the yields per acre for 1910 and for the average of the 18 years, and Table V shows the general results by periods.

DIAGRAM II: PLAN OF FERTILIZING IN 5-YEAR ROTATION

Plots one-tenth acre—Fertilizing materials in pounds per acre

Plot No.	On corn			On oats			On wheat			
	Acid phosphate	Muriate of potash	Nitrate of soda	Acid phosphate	Muriate of potash	Nitrate of soda	Acid phosphate	Muriate of potash	Dried blood	Nitrate of soda
1	....	....	....	....	....	.. .	....	....	....	....
2	80	....	....	80	....	....	160	....	....	....
3	....	80	....	....	80	....	....	100	....	....
4	....	....	....	....	....	....	.. .	....	....	....
5	....	....	160	....	....	160	....	....	50	120
6	80	....	160	80	....	160	160	....	50	120
7	....	....	....	....	....	....	....	....	....	....
8	80	80	....	80	80	....	160	100	....	.. .
9	....	80	160	....	80	160	....	100	50	120
10	....	....	....	....	....	....	.. .	....	....	....
11	80	80	160	80	80	160	160	100	50	120
12	80	80	240	80	80	240	160	100	50	200
13	....	....	....	....	....	....	....	....	....	....
14	80	80	160	....	....	....	160	100	50	120
15	....	....	....	....	....	....	160	100	50	120
16	....	....	....	....	....	....	....	....	....	....
17	160	80	80	160	80	80	160	100	25	60
18	Barnyard manure, 8 tons on corn and wheat									
19	....	....	....	....	....	....	....	....	....	....
20	Barnyard manure, 4 tons on corn and wheat									
21	Same elements as 17, but nitrogen in oilmeal									
22	....	....	....	....	....	....	....	....	....	....
23	Same elements as 17, but nitrogen in dried blood									
24	Same elements as 17, but nitrogen in sulphate ammonia									
25	....	....	....	....	....	...	....	....	....	...
26	Same elements as 11, but phosphorus in bone meal									
27	Same elements as 11, but phosphorus in dissolved bone black*									
28	....	....	....	....	....	....	....	....	....	....
29	Same elements as 11, but phosphorus in basic slag									
30	Same elements as 17, but nitrogen in tankage									

*Previous to 1910. Since 1910 nitrogen in nitrate of lime and phosphorus in acid phosphate.

TABLE III: CROPS GROWN IN 5-YEAR ROTATION

Yield and increase per acre, 1912. Total fertilizing elements for one rotation

Plot No.	Fertilizing elements: Nitrogen Lbs.	Phosphorus Lbs.	Potassium Lbs.	Corn: Grain Bus.	Corn: Stover Lbs.	Oats: Grain Bus.	Oats: Straw Lbs.	Wheat: Grain Bus.	Wheat: Straw Lbs.	Hay: Clover Lbs.	Hay: Timothy Lbs.	Plot No.
Yield per acre												
1	....	....	....	Crop of 1912 not included on account of injury by white grub.		40.47	1,885	1.29	192	1,458	2,498	1
2	....	20	....			53.75	2,000	7.96	805	1,593	2,969	2
3	....	....	108			42.03	1,645	1.70	225	960	2,000	3
4	....	....	....			35.47	1,355	1.71	240	1,049	1,796	4
5	76	....	....			41 87	1,570	1.25	255	1,591	2,738	6
6	76	20	....			56.09	2,490	10.21	1,137	2,944	3,609	6
7	....	....	....			35.47	1,525	1.58	292	1,404	1,858	7
8	....	20	108			54.45	2,517	10.16	810	2,667	2,747	8
9	76	....	108			48 67	2,402	1.59	187	1,902	2,498	9
10	....	....	....			33.12	1,370	1.00	127	1,067	2,000	10
11	76	20	108			65.55	3,732	9.75	997	3,182	3,236	11
12	112	20	108			65.86	3,562	9.25	1,165	3.573	3,040	12
13	....	....	....			33 83	1,707	.91	165	1,324	1,591	13
14	50	15	74			46.95	2,227	8 87	947	2,213	2,196	14
15	25	10	41			37.10	1,442	8.21	1,055	2,444	1,831	15
16	....	....	....			30 70	1,157	.79	167	1,280	1,360	16
17	38	30	108			59.68	2,840	8.58	937	3,049	2,267	17
18	144	48	112			48.12	2,290	10.95	1,335	3,804	3,645	18
19	....	....	....			31.33	1,307	1.33	267	1,484	1,680	19
20	72	24	56			40.07	1,767	6.33	745	2,649	3,093	20
21	38	30	108			56.40	2,835	7.00	665	2,391	2,791	21
22	...	....	....			31.74	1,382	.83	152	1,138	1,796	22
23	38	30	108			57.18	3,090	6.37	605	2,178	2,791	23
24	38	30	108			58.74	3,430	8.00	890	2,133	2,933	24
25	....	....	....			35 54	2,092	.50	90	1,449	2,231	25
26	76	20	108			56.32	3,097	5.25	722	2,578	3,049	26
27	76	20	108			54.92	3,462	9.79	1,077	1,938	2,924	27
28	....	....	....			33.59	1,485	.50	115	1,111	2,604	28
29	76	20	108			50 78	2,375	6.79	967	2,809	3,591	29
30	38	30	108			48.20	2,385	5.58	765	2,471	3,956	30
Average unfertilized yield						34.12	1,527	1.05	181	1,276	1,942	
Increase per acre												
2	....	20	....			14.95	292	6.53	596	251	705	2
3	....	....	108			4.89	113	.13	1	—225	—30	3
5	76	....	....			6.40	158	—.42	—2	424	921	5
6	76	20	....			20.63	1,022	8.59	862	1,558	1,772	6
8	....	20	108			19.76	1,044	8.77	810	1,375	842	8
9	76	....	108			14.77	980	.41	5	723	545	9
11	76	20	108			32.26	2,250	8.78	857	2,030	1,373	11
12	112	20	108			32.27	1,967	8.30	1,013	2,335	1,313	12
14	50	15	74			14.16	703	8.00	783	908	682	14
15	25	10	41			5.36	102	7.35	891	1,147	394	15
17	38	30	108			28.77	1,633	7.62	736	1,700	800	17
18	144	48	112			17.00	933	9.80	1,100	2,387	2,072	18
20	72	24	56			8.60	435	5.16	516	1,280	1,374	20
21	38	30	108			24.80	1,478	5.99	475	1,138	1,033	21
23	38	30	108			24.18	1,472	5.66	474	938	850	23
24	38	30	108			24.47	1,575	7.39	778	788	847	24
26	76	20	108			21.43	1,207	4.75	625	1,242	694	26
27	76	20	108			20.68	1,775	9.29	970	714	444	27
29	76	20	108			17.19	890	6.29	852	1,698	987	29
30	38	30	108			14.61	900	5.08	650	1,360	1,352	30

In all these experiments the increase has been computed on the assumption that changes in the natural fertility of the soil are likely to be progressive; that is, that if the yields of Plots 1 and 4, unfertilized, were 30 and 33 bushels, respectfully, those of Plots 2 and 3 would probably have been 31 and 32 bushels, had no fertilizers been applied. As a rule the outcome of the work has justified this assumption, but in the manure test the yields of Plots 1 and 11, Section C, have been so much larger than those of the other unfertilized plots of the series that the question has been raised whether these plots (which are continuous) may not have been located on a strip of land—such as an old fence row—which has not been so depleted of its fertility under previous management as that covered by the adjoining plots.

TABLE IV: CROPS GROWN IN 5-YEAR ROTATION

Average annual yield and increase per acre for the 19 years, 1894-1912

Plot No.	Fertilizing elements			Corn*		Oats		Wheat		Hay		Plot No.
	Nitrogen Lbs.	Phosphorus Lbs.	Potassium Lbs.	Grain Bus.	Stover Lbs.	Grain Bus.	Straw Lbs.	Grain Bus.	Straw Lbs.	Clover Lbs.	Timothy Lbs.	
Yield per acre												
1	...	..	...	30.71	1,673	32.28	1,354	10.12	1,083	1,985	2,874	1
2	...	20	...	37.83	1,871	40.73	1,683	18.12	732	2,510	3,123	2
3	...	..	108	34.60	1,929	34.92	1,418	12.57	1,229	2,239	2,921	3
4	...	..	...	29.62	1,642	31.00	1,281	10.52	1,076	2,007	2,743	4
5	76	..	...	34.65	1,822	35.17	1,418	12.31	1,365	2,341	3,139	5
6	76	20	...	44.61	1,993	45.54	1,978	23.55	2,423	3,132	3,495	6
7	...	..	...	30.35	1,641	31.24	1,280	10.38	1,083	1,937	2,640	7
8	...	20	108	44.09	2,177	42.45	1,881	19.40	1,850	2,902	3,122	8
9	76	..	108	36.16	1,941	37.35	1,670	13.06	1,396	2,320	2,987	9
10	...	..	...	28.93	1,587	30.93	1,257	10.39	1,042	1,848	2,602	10
11	76	20	108	47.47	2,284	50.09	2,283	26.22	2,791	3,312	3,583	11
12	112	20	108	47 89	2,298	49.51	2,343	26.85	2,865	3,413	3,485	12
13	...	..	...	29.19	1,614	31.02	1,332	10.34	1,013	1,905	2,572	13
14	50	15	74	44.44	2,188	39.44	1,715	24.33	2,561	2,920	3,203	14
15	25	10	41	32.33	1,840	41.31	1,703	23.32	2,417	2,564	2,927	15
16	...	..	...	27.09	1,613	28.60	1,207	9.25	916	1,726	2,478	16
17	38	30	108	44.12	2,260	48.84	2,338	21.64	2,253	3,096	3,264	17
18	144	48	112	49.00	2,460	42.88	2,022	21.65	2,345	3,890	4,071	18
19	...	..	...	30.54	1,715	30.73	1,300	10.19	1 052	1,886	2,614	19
20	72	24	56	43.71	2,178	37.81	1,673	17.72	1,878	2,972	3,513	20
21	38	30	108	46.46	2,255	47.57	2,188	23.06	2,398	2,889	3,125	21
22	...	..	...	27.73	1,662	29.80	1,242	9.77	978	1,650	2,377	22
23	38	30	108	46.58	2,264	47.75	2,150	21.96	2,203	2,825	3,119	23
24	38	30	108	47.03	2,288	49.01	2,372	22.53	2,279	2,960	3,089	24
25	...	..	...	30.67	1,743	31.17	1,375	10 61	1,115	1,926	2,710	25
26	76	20	108	45.47	2,304	46.90	2,090	22.90	2,368	3,444	3,666	26
27	76	20	108	47.31	2,313	49.14	2,304	25.34	2,595	3,042	3,488	27
28	...	..	...	32.58	1,800	32.55	1,346	10.40	1,020	1,972	2,903	28
29	76	20	108	47.77	2,402	47.35	2,067	23.93	2,503	3,272	3,836	29
30	38	30	108	47.72	2,261	44.74	1,988	21.74	2,142	3,296	3,826	30
Average unfertilized yield...				29.74	1,668	31.00	1,300	10.21	1,045	1,883	2,651	
Increase per acre												
2	...	20	...	7.48	208	8.88	353	7.88	732	550	293	2
3	...	..	108	4.62	277	3.50	112	1.19	150	239	134	3
5	76	..	...	4.79	181	4.09	148	1.86	286	357	430	5
6	76	20	...	11.50	352	15.43	698	13.13	1,343	1,172	840	6
8	...	20	108	14.22	554	12.43	606	9.02	781	995	495	8
9	76	..	108	6.76	336	6.32	401	2.67	341	442	374	9
11	76	20	108	18.46	688	19.13	997	15.85	1,742	1,445	991	11
12	112	20	108	18.76	693	18.57	1,045	16.49	1,809	1,528	903	12
14	50	15	74	15.96	575	8.99	419	14.36	1,547	1,075	662	14
15	25	10	41	7.61	261	3.70	159	13.70	1,452	778	417	15
17	38	30	108	18.91	649	19.04	1,100	12.60	1,292	1,320	740	17
18	144	48	112	22.96	824	12.14	742	11.77	1,338	2,065	1,504	18
20	72	24	56	14.11	480	7.40	393	7.66	851	1,167	980	20
21	38	30	108	17.79	575	17.44	910	13.16	1,395	1,159	670	21
23	38	30	108	17.87	575	17.49	864	11.91	1,269	1,083	631	23
24	38	30	108	17.34	572	18.30	1,042	12.14	1,209	1,126	489	24
26	76	20	108	14.16	541	15.27	724	12.35	1,284	1,503	892	26
27	76	20	108	15.37	532	17.06	948	14.87	1,544	1,087	650	27
29	76	20	108	15.19	602	14.81	721	13.53	1,483	1,300	933	29
30	38	30	108	15.14	461	12.19	642	11.35	1 122	1 324	925	30

*The average annual yield and increase per acre for corn is given for the 18 years, 1894-1911, the crop of 1912 being practically destroyed by grubs.

TABLE V. TOTAL FERTILIZING MATERIALS AND THEIR COST, AND TOTAL AND NET VALUE OF INCREASE PRODUCED FOR 5-YEAR PERIODS AND FOR 19 YEARS, ALL CALCULATED FOR ONE ROTATION OF 5 YEARS

Plot No.	Fertilizing materials in pounds per acre for each rotation	Cost of fertilizers for each rotation	Average value of total increase per acre for each rotation				Net gain or loss (—) from fertilizers for each rotation				Plot No.
			First 5-years	Second 5-years	Third 5-years	19-year average Total	First 5-years	Second 5-years	Third 5-years	19-year average Net	
2	Acid phosphate, 320	$ 2.60	$ 8.50	$ 17.37	$ 24.32	$ 16.71	$ 5.90	14.77	$ 21.72	$ 14.11	2
3	Muriate potash, 260	6.50	5.19	4.67	9.17	6.02	—1.31	—1.83	2.67	—0.48	3
5	Nitrate soda, 440; dried blood, 50	14.40	4.70	10.47	9.30	8.50	—9.70	—4.00	—5.37	—5.90	5
6	Acid phosphate, 320; nitrate soda, 440; dried blood, 50	17.00	19.09	35.27	39.75	30.35	2.09	18.27	22.75	13.35	6
8	Acid phosphate, 320; muriate potash, 260	9.10	14.40	24.37	33.51	24.81	5.30	15.27	24.41	15.71	8
9	Muriate potash, 260; nitrate soda, 440; dried blood, 50	20.90	5.85	11.35	13.23	11.24	—15.05	—9.55	—6.67	—9.66	9
11	Acid phos., 320; mur. potash, 260; nit. soda, 440; dried blood, 50	23.50	26.39	42.43	49.96	39.31	2.90	18.93	26.46	15.81	11
12	" " 320; " " 260; " " 680; " " 50	30 70	26.16	45.53	48.24	39.88	—4 54	14.83	17.54	9.18	12
14	" " 240; " " 180; " " 280; " " 50	16.05	21 37	32.91	37.33	30.35	5.32	15.86	21.28	14.30	14
15	" " 160; " " 100; " " 120; " " 50	8.60	13.89	22.86	27.13	21.89	5 29	14.26	18.53	13.29	15
17	" " 480, " " 260; " " 220; " " 25	17.60	15.74	36.61	46.28	34.95	—1.86	19.01	28.68	17.35	17
18	Yard manure, 16 tons	?	19.82	34.24	55.94	39.84	?	?	?	?	18
20	Yard manure, 8 tons	?	13.02	21.28	35 36	24 54	?	?	?	?	20
21	Same elements as 17, but nitrogen in oilmeal	17.60	20.43	36.25	42 24	33 36	2 83	18.65	24 64	15.76	21
23	" " " 17, " " " " dried blood	17.60	19.09	34.37	39.28	31.78	1.49	16.77	21.68	14.18	23
24	" " " 17, " " " " sulphate ammonia	17 60	20.70	32.77	38.71	31.71	3.10	14.77	21.11	14.11	24
26	" " " 11, " phosphorus in bonemeal	23.50	20.89	36.17	42.55	32.51	—2.61	12.67	19.05	9.01	26
27	" " " 11, " " " " dissolved boneblack*	23.50	19.86	39.88	42.08	33.41	—3.64	16.38	18.58	9.91	27
29	" " " 11, " " " " basic slag	23.50	21 91	39.32	39.04	33.37	—1.59	15.82	15.54	9.87	29
30	" " " 17, " nitrogen in tankage	**17.60	13.74	30.51	41.62	30.24	..	12.90	24.02	12.64	30

The nearest practicable approach to a common denominator for the various kinds of produce grown in this rotation is their market value, and in Table VI the results of the tests are arranged on this basis for three 5-year periods and for the entire 18 years, corn being rated at 40 cents per bushel, oats at 30 cents, wheat at 80 cents, hay at $8.00 per ton, stover at $3.00 and straw at $2.00; valuations much below present prices for the grains, but not far from the average values during the period of the test.

The fertilizing materials are valued at a fraction over $16.00 per ton for acid phosphate, 2½ cents per pound for muriate of potash and 3 cents per pound for nitrate of soda; and it is assumed that the cost per pound of the fertilizing elements will be practically the same in the other carriers used on Plots 21 to 30, inclusive.

The table shows that the effectiveness of the fertilizers and manure has increased with each successive period, the greatest relative increase being shown by the manure. Taking the second part of the table, giving the net gain after deducting the cost of the fertilizers, it will be seen that during the first period eight of the fertilizer applications failed to produce sufficient increase to cover their cost; during the second period three, and during the third period two. Every complete fertilizer has been used with a profit since the first period, but when either nitrate of soda or muriate of potash has been used unaccompanied by some carrier of phosphorus there has been a loss in each period and in the average of the 19 years.

Nevertheless, both nitrogen and potassium are essential to the highest net profit, as shown by comparing Plot 2, receiving phosphorus only, with Plot 8, receiving potassium in addition, and Plot 11, receiving these with nitrogen.

The results of the comparison of different carriers of nitrogen and phosphorus have been discussed in Circular No. 93.

*Previous to 1910. Since 1910 nitrogen in nitrate of lime and phosphorus in acid phosphate.

**Since first period. Smaller application during first period.

THE POTATOES-WHEAT-CLOVER ROTATION

This experiment is located on the South Farm southeast of the orchards, and contains three sections of 34 plots each. The south section (A) and about half of the middle section (B) had been in cultivation for an unknown period before the test began. The north part of section B and all of the north section (C) were cleared from the forest for the purposes of this test. The old land was tile drained in 1893, and the work was begun by planting section A to potatoes in 1894. Wheat and clover followed in 1895 and 1896 and the rotation has been maintained regularly since.

The potato crops in this test have in some seasons been somewhat injured by blight, and in 1904 a dashing rain, coming just after the potatoes had been planted, washed much of the seed out of the ground. These difficulties have caused an irregular stand, and for this reason the attempt has been made to correct the yields on the basis of the average stand obtained on the unfertilized plots, but this method has not proved satisfactory and hence the actual yields are given in the table. In 1909 the potatoes were reduced to about one-third the average crop by a combined attack of white grub and Fusarium wilt, the latter causing the larger part of the injury. The crop was severely injured by wilt again in 1910 and considerably injured in 1911.

In 1895 and 1896 the wheat in this test was severely injured by Hessian fly, but it escaped the attack of 1899 to 1901. In 1911 there was again some injury from fly and joint worm.

In 1909 the clover failed; attempts were made to grow crimson clover and soybeans in its stead, but there was failure in securing a stand of these crops also, so that it has been necessary to omit that season from the calculations. In 1905 continuous rains prevented harvesting the clover until very late, and caused the fertilized plots to lodge so that these plots weighed less than those not fertilized, though earlier in the season they had shown a distinctly stronger growth. As there was no way by which the yields could be corrected and as it seemed desirable to include the crop in the general average because of its effect on the average unfertilized yield it has been so included, although the doing so slightly reduces the apparent average effect from the fertilizers.

Diagram III shows the arrangement of plots and plan of fertilizing one of the sections in this experiment, the three sections being arranged and treated alike. Tables VI and VII give the yield per acre for 1912 and for the 19 years, 1894-1912.

DIAGRAM III: PLAN OF FERTILIZING IN POTATOES-WHEAT-CLOVER ROTATION

PLOTS ONE-TENTH ACRE — Fertilizing materials in pounds per acre

Plot No.	On Potatoes			On Wheat			
	Acid phosphate	Muriate potash	Nitrate soda	Acid Phosphate	Muriate potash	Dried blood	Nitrate soda
1	....	....	....	....	....	....	....
2	160	....	....	160	....	....	....
3	....	100	....	....	100	....	....
4	....	....	....	....	....	....	....
5	....	....	80	....	....	50	120
6	160	....	80	160	....	50	120
7	....	....	....	....	....	....	....
8	160	100	....	160	100	....	....
9	....	100	80	....	100	50	120
10	....	....	....	....	....	....	....
11	160	100	80	160	100	50	120
12	160	100	160	160	100	50	200
13	....	....	....	....	....	....	....
14	320	200	160	160	100	50	120
15	480	300	320	....	....	....	....
16	....	....	....	....	....	....	....
17	....	....	....	Manure, 4 tons on wheat			
18	....	....	....	Manure, 8 tons on wheat			
19	....	....	....	....	....	....	....
20	160	100	80	160	100	25	60
21	Same elements as 20, but nitrogen in oilmeal						
22	....	....	....	....	....	....	....
23	Same elements as 20, but nitrogen in dried blood						
24	Same elements as 20, but nitrogen in sulphate ammonia						
25	....	....	....	....	....	....	....
26	Same elements as 11, but phosphorus in bonemeal						
27	Same elements as 20, but nitrogen in nitrate of lime*						
28	....	....	....	....	....	....	....
29	Same elements as 11, but phosphorus in basic slag						
30	Manure, 8 tons on potatoes			....	....	....	....
31	....	....	....	....	....	....	....
32	....	....	....	Manure, 16 tons on wheat			
33	Same elements as 20, but nitrogen in tankage						
34	....	....	....	....	....	....	....

*Since 1910; previously same elements as 11.

CROPS IN 3-YEAR ROTATION OF POTATOES, WHEAT AND CLOVER

TABLE VI: Yield per acre 1912, and average for 19 years, 1894-1912

Fertilizing elements for each rotation

Plot No.	Fertilizing elements: Nitrogen Lbs.	Fertilizing elements: Phosphorus Lbs.	Fertilizing elements: Potassium Lbs.	Potatoes: 1912 Bus. (actual)	Potatoes: 19-yr. av. Bus.	Wheat: 1912 Grain Bus.	Wheat: 1912 Straw Lbs.	Wheat: 18-yr. av. Grain Bus.	Wheat: 18-yr. av. Straw Lbs.	Clover: 1912 Lbs.	Clover: 17-yr. av. Lbs.	Plot No.
1	..	..	...	79.83	149.06	10 25	1,445	29.64	3,084	3,700	4,271	1
2	..	20	..	78 42	161.79	15.71	1,957	35.43	3,728	4,420	4,499	2
3	..	..	83	118.33	163 55	11.67	1,460	31.08	2,943	4,190	4,185	3
4	..	..	...	80.83	152.83	13.24	1,460	29.42	2,901	4,470	3,949	4
5	38	..	...	108.92	158 94	13.54	1,767	28.06	3,147	4 900	4,270	5
6	38	20	...	121.83	164.95	18.08	2,115	35.46	3,801	5,330	4,437	6
7	..	..	...	126.67	143.44	8.87	1,227	27 51	2,729	3,890	3,863	7
8	..	20	83	136.92	174.77	16.08	1,815	35.48	3,356	3,990	4,147	8
9	38	..	83	136.00	161.19	12.12	1,832	33.05	3,152	4,020	4,334	9
10	..	..	...	85.42	143.32	11.62	1,442	28 65	2,597	3,000	3,686	10
11	38	20	83	166.00	172.11	18 04	2,177	37.44	3,701	4,140	4,305	11
12	50	20	83	177.92	178.32	17 53	2,327	37.17	3,883	4,690	4,501	12
13	..	..	...	106.58	143.85	11.33	1'720	27.91	2,676	2,830	3,837	13
14	50	30	124	193.58	180.43	16.12	2,352	38.18	3,883	4,030	4,439	14
15	50	30	124	195 75	177.02	13.83	1,950	35 92	3,556	3,500	4,402	15
16	..	..	...	93.67	134.13	11.96	1,582	27 86	2,495	2,670	3,581	16
17	36	12	28	123 67	124 48	12 96	2,022	30.98	3,090	4,500	4,275	17
18	72	24	56	152.08	130.89	11.50	2,250	32 05	3,264	5,820	4,731	18
19	..	..	...	121.75	133 35	7.33	1,520	23.78	2,349	3,160	3,352	19
20	25	20	83	127.33	173 07	14.42	2,735	33.66	3,412	4,110	4,205	20
21	25	20	83	155 92	166.83	12.25	2,815	33.43	3,301	3,150	3,785	21
22	..	..	...	90.50	133.62	6.54	1,787	23.30	2 211	2,420	3,317	22
23	25	20	83	163 08	163.92	11.83	2,510	34.12	3,353	3,970	3 816	23
24	25	20	83	170 75	170 36	13 83	2,870	34.36	3,302	4,200	3,845	24
25	..	..	...	86.17	132.64	8·25	1,645	23.96	2,320	3'230	3,396	25
26	38	20	83	150.50	164.87	11.87	2,927	34.22	3,368	5,190	4,244	26
27	38	20	83	146.08	169.34	10.00	2,600	35.49	3,668	5,090	4,077	27
28	..	..	...	78.17	134.85	5.87	1,307	24.06	2,385	3'610	3,546	28
29	38	20	83	181.75	170.35	13.04	2,537	35 99	3,699	6,220	4,569	29
30	72	24	56	163.75	180.08	6.92	2,045	31.10	3,123	5,170	4,452	30
31	..	..	...	104.08	140.19	6·08	1,355	23.89	2,402	3,890	3,531	31
32	144	48	112	203.00	157.27	11.04	2,987	36.86	3,934	6,980	5,220	32
33	25	20	83	168.17	161.46	11.25	2,745	36.77	3,522	6,910	4,279	33
34		..	...	114 83	128.73	6.50	2,110	25 57	2,527	3,930	3,533	34
Average unfertilized yield.....				97 36	139.59	8.91	1,550	26.03	2,553	3,400	3,661	

TABLE VII. Increase per acre, and annual average of 19 years, 1894-1912

Cost of fertilizer for 1 rotation and 19-year average value of increase for each rotation

Plot No.	Potatoes: 1912 Bus. (actual)	Potatoes: 19-yr. av. Bus.	Wheat: 1912 Grain Bus.	Wheat: 1912 Straw Lbs.	Wheat: 18-year av. Grain Bus.	Wheat: 18-year av. Straw Lbs.	Clover: 1912 Lbs.	Clover: 16-yr. av. Lbs.	Cost of fertilizers	Value of increase for one rotation: Total	Value of increase for one rotation: Net	Plot No.
2	—1.74	11.47	4.77	507	6.45	705	463	336	$ 2.60	$11.79	$ 9.19	2
3	37.83	11.97	03	5	1.63	—18	—23	129	5.00	6.59	1.59	3
5	12.81	9.24	2.36	385	.87	304	623	350	7 20	6 11	—1.09	5
6	10 44	18.38	8.06	810	7.34	1,015	1,247	545	9.80	16.40	6.60	6
8	24.00	31.37	6.29	412	7.59	629	397	343	7.60	20.62	13.02	8
9	36.83	17.83	1.42	410	4.78	464	723	591	12.20	13.77	1.57	9
11	73.53	28.61	6.52	642	9.04	1,060	1,197	569	14.80	23.01	8.21	11
12	78.39	34.63	6.11	700	9.01	1,196	1,803	714	19.60	25.12	5.52	12
14	91.30	39.82	4.58	678	9.55	1,267	1,253	688	21.00	27.59	6.59	14
15	97.78	39.65	2.08	322	8.79	1,006	777	736	21.00	26.84	5.84	15
17	20.64	15.87	2.54	461	5.22	643	1,667	770	?	14.25	?	17
18	39.69	23.46	2.63	709	7.28	822	2,823	1,303	?	21 23	?	18
20	16.00	39 93	7.35	1,126	10 05	1,110	1,197	865	12.40	28.58	16.18	20
21	55.00	33.30	5.45	1,117	9.92	1,044	483	456	12 40	24.12	11.72	21
23	74.02	30.62	4.72	770	10.60	1,101	1,280	473	12.40	23.72	11.32	23
24	83.14	37.36	6.15	1,178	10.62	1,018	1,240	476	12.40	26.36	13.96	24
26	67.00	31.46	4.41	1,395	10.23	1,025	1,833	798	12.80	24.97	12.17	26
27	65.24	35.73	3.34	1,180	11.47	1,304	1,607	581	12.80	27.09	14.29	27
29	94.94	33 72	7.10	1,214	11.99	1,309	1,517	1,028	12.80	28.50	15.70	29
30	68.31	41.67	.91	706	7 16	727	1,373	917	?	26.80	?	30
32	95.34	47.41	4.82	1,380	10.92	1,338	3,077	1,688	?	35.79	?	32
33	56 92	32 67	4.89	887	11.01	948	993	604	12.40	25.25	12.85	33

BARNYARD MANURE TEST

COMPARISON OF YARD WITH FRESH MANURE. THE REINFORCEMENT OF MANURE

This experiment was begun in 1897 for the purpose of comparing manure which has lain for some months in an open barnyard with that taken directly from the stable to the field, and of studying the effect of treating the manure with several absorbent or reinforcing materials. In the earlier years of this investigation a lot of manure was taken from the open barnyard, where it had been accumulating during the winter, and divided into four parcels. With one parcel was mixed the finely ground phosphatic rock, known as floats, from which acid phosphate is made by mixing it with sulphuric acid; with another parcel acid phosphate was mixed; with a third, the crude potash salt, known as kainit, and with a fourth, land plaster or gypsum; the reinforcing materials being used at the uniform rate of 40 pounds per ton of manure. At the same time manure taken from box stalls, where it had accumulated under the feet of animals kept continuously in their stalls, was divided into similar parcels and treated with like quantities of the same materials.

After a few weeks the manure thus treated, together with two lots of untreated manure, one taken from the yard and one from the stable, was spread upon clover sod at the rate of eight tons per acre and plowed under for corn, the corn being followed by wheat and clover in a 3-year rotation. During the first three seasons soybeans were grown, because of clover failure, and were plowed under.

Because of the uncertainty as to the quantity of fresh manure required to produce a ton of yard manure under these conditions the plan was changed in 1903 and since then a sufficient quantity of fresh manure for the purpose of the experiment is weighed out of the stables in December or January and forked over carefully to secure a uniform product. The manure is then divided into five equal parcels, four of which are treated as above indicated, and the fifth is left untreated. Each parcel is then divided into two equal portions, one of which is immediately spread upon the plots receiving "stall manure," while the other is placed in a flat, compact pile in an open yard where it remains undisturbed until April, when it is spread on the "yard manure" plots, and the whole is plowed under at the rate of 8 tons per acre of the original manure.

Three tracts of land, A, B and C, are included in the test, each crop being grown every season. The arrangement of these tracts and the plan of fertilizing are shown in Diagram IV, and the results are given in Tables VIII and IX.

DIAGRAM IV: ARRANGEMENT OF PLOTS AND PLAN OF FERTILIZING IN EXPERIMENTS WITH MANURE

PLOTS ONE-SIXTEENTH ACRE

11	Nothing	Nothing	1
12	Yard manure and gypsum	Yard manure and floats	2
13	Stall manure and gypsum	Stall manure and floats	3
14	Nothing	Nothing	4
15	Yard manure, untreated	Yard manure and acid phos.	5
16	Stall manure, untreated	Stall manure and acid phos.	6
17	Nothing	Nothing	7
18	Chemical fertilizer	Yard manure and kainit	8
19	Chemical fertilizer	Stall manure and kainit	9
20	Nothing	Nothing	10

SECTION A

11	Nothing	Nothing	1
12	Yard manure and gypsum	Yard manure and floats	2
13	Stall manure and gypsum	Stall manure and floats	3
14	Nothing	Nothing	4
15	Yard manure, untreated	Yard manure and acid phos.	5
16	Stall manure, untreated	Stall manure and acid phos.	6
17	Nothing	Nothing	7
18	Chemical fertilizer	Yard manure and kainit	8
19	Chemical fertilizer	Stall manure and kainit	9
20	Nothing	Nothing	10

SECTION B

11	Nothing	Nothing	1
12	Yard manure and gypsum	Yard manure and floats	2
13	Stall manure and gypsum	Stall manure and floats	3
14	Nothing	Nothing	4
15	Yard manure, untreated	Yard manure and acid phos.	5
16	Stall manure, untreated	Stall manure and acid phos.	6
17	Nothing	Nothing	7
18	Chemical fertilizer	Yard manure and kainit	8
19	Chemical fertilizer	Stall manure and kainit	9
20	Nothing	Nothing	10

SECTION C

NORTH

TABLE VIII: BARNYARD MANURE ON CROPS GROWN IN 3-YEAR ROTATION

Average yield per acre 1912 and 16 years 1897-1912

Plot No.	Manure and treatment	1912				Clover Sec. C	16 years, 1897-1912				Hay 12 crops	Plot No.
		Corn, Sec. A		Wheat, Sec. B			Corn* 15 crops		Wheat 15 crops			
		Grain Bus.	Stover Lbs.	Grain Bus.	Straw Lbs.	Lbs.	Grain Bus.	Stover Lbs.	Grain Bus.	Straw Lbs.	Lbs.	
	Yield per acre											
1	None	40.20	3,296	3.53	828	5,432	38.07	2,367	11.98	1,471	3,121	1
2	Yard manure and floats	78.63	4,096	10.93	1,480	7,281	71.79	3,472	24.01	2,614	4 540	2
3	Stall manure and floats	79.66	3,840	10.00	1,596	7,168	65.41	3,680	25.39	2,791	5,021	3
4	None	32.97	2,208	3.27	968	2,560	31.58	2,066	10.48	1,258	2,335	4
5	Yard manure and acid phosphate	67.49	3,424	12.60	1,940	6,712	62.31	3,357	24.18	2,684	4,376	5
6	Stall manure and acid phosphate	72.17	4,032	10.47	1,708	7,811	66.05	3,581	25.47	2,837	5,077	6
7	None	30.51	2,144	2 20	956	3,014	30.86	1,997	9.34	1,182	2,361	7
8	Yard manure and kainit	63.60	3,680	5.53	1,404	5,688	56.05	3,287	20.26	2,327	3,700	8
9	Stall manure and kainit	70.17	3,616	7.20	1,624	6,798	61.04	3,548	21.85	2,596	4,490	9
10	None	31.20	1,984	2.93	1,028	2,872	33.39	2,047	9.86	1,243	2,521	10
11	None	49.83	3,200	1.53	1,292	5,120	38.63	2,436	12.98	1,647	3,343	11
12	Yard manure and gypsum	71.20	4,160	10.27	1,948	6,002	60.26	3,467	23 44	2,661	4,006	12
13	Stall manure and gypsum	62.91	3,680	8.07	1,568	5,802	61.62	3,572	23.11	2,603	4,030	13
14	None	32.80	2,432	3.20	1,144	3,072	32.01	2,077	10.10	1,218	2,423	14
15	Yard manure, untreated	62.17	3,456	6.07	1,796	5,461	53 17	2,985	19.26	2,194	3,446	15
16	Stall manure, untreated	59.94	3,200	6.60	1,840	6,286	59.49	3,358	20.69	2,368	4,149	16
17	None	31.20	2,208	4.27	1,332	3,583	37.42	2,363	10.50	1,327	2,735	17
18	Chemical fertilizer†	62.11	3,488	4.00	1,568	4,152	46.20	2,731	14.22	1,701	3,248	18
19	Chemical fertilizer‡	52.74	3,040	4.47	1,808	3,442	45.54	2,549	14.49	1,804	3,382	19
20	None	20.06	1,504	3.67	1,516	2,730	33.14	2,010	9.95	1,317	2,736	20
	Average unfertilized yield	33.60	2,372	3.07	1,125	3,544	34.39	2,169	10.63	1,310	2,697	

*Excluding crop of 1909 which was so injured by grub worms that no comparison is possible.
†Acid phosphate, 80 lbs.; muriate of potash, 80 lbs.; nitrate of soda, 160 lbs.
‡Acid phosphate, 80 lbs.; muriate of potash, 10 lbs.; tankage (7-30), 100 lbs.

TABLE IX: BARNYARD MANURE ON CROPS GROWN IN 3-YR. ROTATION

Average annual increase and its value (excluding corn crop of 1909)

Plot No.	Manure and treatment	Average annual increase per acre					Cost of treatment per acre	Value of increase	
		Corn 15 crops		Wheat 15 crops		Hay 12 crops Lbs.		Total per acre for one rotation	Net per ton of manure
		Grain Bus.	Stover Lbs.	Grain Bus.	Straw Lbs.				
2	Yard manure and floats	25.88	1,406	12.53	1,215	1,681	$1.40	$30.41	3.63
3	Stall manure and floats	31.67	1,514	14.42	1,462	2,423	1.40	37.63	4.53
5	Yard manure and acid phos.	30.97	1,314	14.75	1,451	2,032	2.40	35.74	4.17
6	Stall manure and acid phos.	34.95	1,561	15 75	1,630	2,724	2.40	41.45	4.88
8	Yard manure and kainit	24.35	1,274	10.74	1,125	1,286	2 70	26.50	2.97
9	Stall manure and kainit	28.49	1,519	12.16	1,373	2,022	2.70	32.87	3.77
12	Yard manure and gypsum	23.84	1,151	11.42	1,157	970	1 00	25.45	3.06
13	Stall manure and gypsum	27.41	1,375	12.05	1,242	1,301	1.00	29.10	3.51
15	Yard manure untreated	19.36	813	9.02	940	920	....	20 43	2.55
16	Stall manure untreated	23 88	1,091	10.32	1,085	1,520	....	26.61	3 33
18	Chemical fertilizer[1]	10.21	485	3.90	378	513	7.45	10.14	....
19	Chemical fertilizer[2]	10.97	421	4.45	484	646	2.30	11.37	...

[1]Acid phosphate, 80 lbs; muriate of potash, 80 lbs; nitrate of soda, 160 lbs.
[2]Acid phosphate, 80 lbs; muriate of potash, 10 lbs; tankage, (7-30) 100 lbs.

In Table X the average total yields obtained on the plots treated with floats and acid phosphate are arranged by sections:

TABLE X: Average total yields in plots treated with floats and acid phosphate, arranged by sections

Crop and section*		Yard manure		Stall manure	
		With floats	With acid phosphate	With floats	With acid phosphate
Corn, bus.:	A	51.92	54.29	62.20	61.00
	B	71.36	74.33	76.00	74.64
	C	54 39	58.31	58.04	62.52
Wheat, bus.:	A	22.05	23.22	24 89	24.95
	B	26.56	27.96	27.23	25 83
	C	23.41	23.35	24.07	25.64
Hay, lbs.	A	4,752	4,373	5,255	4,995
	B	3,720	3,836	4,030	4,007
	C	5,148	4,919	5,776	6,230

*The differences in yield of the different sections are chiefly due to seasonal differences, not to variation of soil.

In 10 of the 18 comparisons given in Table X the total yields on the plots treated with acid phosphate have exceeded those on the plots treated with floats. The general average of all the sections is shown below:

AVERAGE ANNUAL YIELD PER ACRE

Treatment	Corn Bus.	Wheat Bus.	Hay Lbs.
Yard manure and floats	61.79	24 01	4,540
Yard manure and acid phosphate	62.81	24.18	4,376
Stall manure and floats	65.41	25.39	5,021
Stall manure and acid phosphate	66.05	25.47	5,077

It will be observed that the average differences amount to about half a bushel of corn, half a peck of wheat, and 54 pounds of hay in the average for the two manures.

LIME AND FLOATS TEST

This experiment was begun in 1905 in a 3-year rotation of corn, oats and clover, for the purpose of comparing the effect of different forms of lime and of obtaining further experience in the use of untreated phosphate rock.

The land had been under the regular rotative cropping of the farm since its occupation by the Station, and for a considerable period before, and was in good condition. Twelve tons of manure per acre had been plowed under for corn in 1904. Three sections of 26 plots each are included in the test, the plots containing one-twentieth acre each.

For the crops of 1905 Section A (north end) was manured at the rate of 6 tons per acre only, because of the recent application above mentioned, limed and fertilized and planted in corn. Section B was sown to soybeans instead of clover, the beans to be followed by rye in the fall and corn in 1906. Section C (south end) was limed and fertilized without manure and sown to oats and clover. Thenceforth the manure, lime and fertilizers have all been applied to the corn crops, the manure being plowed under and the lime and fertilizers applied on the surface. The oats and clover receive no treatment.

The clover seeding failed in 1906, 1908 and 1909, and soybeans were grown instead and harvested as hay. As the soybean suffers less from lack of lime than clover the result has been a smaller apparent effect from the lime than might otherwise have been found.

The plan of treatment and average results of the work for the first eight years are given in Table XI.

The 8-year average yield of the unmanured and unfertilized land in this experiment has been 53 bushels of corn, 49 bushels of oats and 2¼ tons of hay per acre. Over such yields the increase from treatment would be expected to be relatively small. It appears, however, that the further applications of manure are being made with profit, and that the supplementing of manure with lime is further increasing the yield. When preceded by manure, ground limestone on Plot 6 is apparently producing a greater total and net gain than an equivalent quantity of caustic lime on Plot 3, or of hydrated lime on Plot 8. When used in the absence of manure, however, caustic lime is followed by a larger total and net gain on Plot 14 than ground limestone on Plot 15.

While the yield on the land receiving 1000 pounds of floats, applied to the surface after the manure has been plowed under, is greater than that on the land similarly treated with gypsum, in neither case is the effect at all comparable with that observed in the barnyard manure test, previously reported, in which one-third this quantity of these materials is mixed with the manure before application. Nor is the effect on clover of either floats or gypsum equal to that of lime or ground limestone.

When used in the absence of manure as a direct application to the land, 320 pounds of floats has produced a much smaller net gain than the same quantity of acid phosphate costing twice as much, as shown in the triplicate comparison of Plots 17 and 18, 20 and 23, and 21 and 24.

So far, therefore, as the result of this experiment may be accepted, they support other experiments of this Station in showing that ground limestone should be used only as a supplement to liberal manuring or fertilizing, and floats only as a reinforcement of manure, and that neither should be regarded as a substitute for manure or fertilizers.

TABLE XI: CROPS GROWN IN 3-YEAR ROTATION UNDER TREATMENT WITH MANURE, LIME AND FLOATS

Average yield and increase for 8 years, 1905-1912 inclusive

Plot No.	Treatment (Lime, manure, etc., per acre, applied to corn only)	Yield per acre					Increase per acre					Total value of increase	Cost of lime and fertilizers	Net gain or loss (—) per acre	Gain per ton of manure	Plot No.
		Corn, 8 years		Oats, 8 years		Hay 7 yrs. Lbs.	Corn		Oats		Hay 7 yrs. Lbs.					
		Grain Bus.	Stover Lbs.	Grain Bus.	Straw Lbs.		Grain Bus.	Stover Lbs.	Grain Bus.	Straw Lbs.						
1	None	53.13	2,887	47.05	2,457	4,390	.....	...	...	...	.....	.....	.....	.....	.....	1
2	Caustic lime, 500 lbs.; manure, 8 tons	70.42	3,607	55.27	2,694	5,397	17.09	689	6.93	297	943	$14.00	$1.50	$12.50	$1.56	2
3	Caustic lime, 1,000 lbs.; manure, 8 tons	72.55	3,702	55.69	2,676	5,584	19.04	647	6 06	340	1,065	15.01	3.00	12.01	1.50	3
4	None	53.71	2,980	50.91	2,276	4,582	.....	...	.....	...	.....	.....	.....	.....	.....	4
5	Caustic lime, 2,000 lbs.; manure, 8 tons	76.06	3,935	66.92	2,733	6,105	21.37	933	5 93	455	1,488	18.13	6.00	12.13	1.52	5
6	Ground limestone, 1780 lbs.; manure 8 tons	75.15	3,782	57.52	2,722	5,831	19.48	757	6.44	442	1,181	16.01	2.70	13.31	1.66	6
7	None	56.66	3,047	51.16	2,282	4,685	.....	...	.....	...	.....	.....	.....	.....	.....	7
8	Air slaked lime, 1,780 lbs.; manure, 8 tons	74.75	3,932	58.12	2,838	5,920	18.67	924	7.65	584	1,367	17.21	5.30	11.91	1.49	8
9	Hydrated lime, 1,320 lbs.; manure, 8 tons.	73.69	3,857	57.69	2,819	5,666	18.20	888	7.90	595	1,245	16.55	4.00	12.55	1.57	9
10	None	54.91	2,930	49.09	2,194	4,290	.....	...	.....	...	.....	.....	.....	.....	.....	10
11	Gypsum, 1,000 lbs.; manure, 8 tons	67.13	3,482	56.25	2,435	4,689	13.45	594	7.23	293	502	10.74	3 00	7.74	.97	11
12	Floats, 1,000 lbs.; manure, 8 tons	67.12	3,487	57.56	2,551	4,875	14.67	628	8.62	480	790	13.04	4.50	8.54	1.07	12
13	None	51.21	2,805	48.86	2,039	3,980	.....	...	.....	...	.....	.....	.....	.....	.....	13
14	Caustic lime, 1,000 lbs.	59.49	3,292	51.56	2,242	4,617	8.30	479	2.61	221	661	7.68	3.00	4.68	....	14
15	Ground limestone, 1,780 lbs	56.63	2,935	49.16	2,032	4,437	5.48	113	.12	28	704	5.24	2.70	2.54	....	15
16	None	51.13	2,830	49.12	1,986	3,909	.....	...	...	...	.....	.....	.....	.....	.....	16
17	Caustic lime, 1,000 lbs.; acid phos., 320 lbs.; muriate potash, 40 lbs.	71.24	3,685	54.59	2,203	5,185	19.32	838	5.48	201	1,188	15.59	6.60	8.99	.....	17
18	Caustic lime, 1,000 lbs.; floats, 320 lbs.; muriate potash, 40 lbs.	67.71	3,550	52.19	2,110	5,143	15.00	687	3.09	92	1,062	12.30	5.45	6.85	....	18
19	None	53.50	2,880	49.09	2,034	4,174	.....	...	.....	...	.....	.....	.....	.....	.....	16
20	Acid phosphate, 320 lbs.	60.92	3,155	49.77	2,040	4,529	7.67	303	.89	36	316	5.09	2.60	2.49	....	20
21	Acid phos., 320 lbs.; mur. of potash, 40 lbs.	65.08	3,435	51.64	2,155	4,738	12.08	612	2.98	180	486	8.76	3.60	5.16	....	21
22	None	52.75	2,795	48.46	1,944	4,291	.....	...	.....	...	.....	.....	.....	.....	.....	22
23	Floats, 320 lbs.	54.81	2,830	49.10	1,984	4,275	3.24	77	1.19	54	91	2.17	1.45	.72	....	23
24	Floats, 320 lbs.; muriate of potash, 40 lbs.	58.26	3,142	48.65	1,951	4,075	7.87	431	1.30	36	—2	4.22	2.45	1.77	....	24
25	None	49.21	2,670	46 80	1,900	3,969	.....	...	.....	...	.....	.....	.....	.....	.....	25
26	Manure, 8 tons since 1909*	57.29	3,155	49.98	2,076	4,527	15.42	412	3.18	173	558	10.12	3.85	6 27	....	26
	Average unfertilized yield	52.93	2,869	48.95	2,123	4,253										

* Previously, floats, 320 lbs.; muriate potash, 40 lbs.; dried blood, 100 lbs.

Notice: The lime and manure are not mixed together. The manure is plowed under and the lime applied to the surface.

THE STRONGSVILLE EXPERIMENTS

The experiments now in progress at Strongsville include a 5-year rotation of corn, oats, wheat, clover and timothy, begun in 1895, and a 3-year rotation of corn, wheat and clover, begun in 1905.

THE 5-YEAR ROTATION

The plan of fertilizing in this rotation is the same as in the similar rotation at Wooster as far as Plot 30, with the addition of 10 plots, treated as shown in Diagram V. The results are given in Tables XII and XIII.

DIAGRAM V: CONTINUATION OF DIAGRAM II. PLAN OF FERTILIZING IN 5-YEAR ROTATION AT STRONGSVILLE

Plots one-tenth acre — Fertilizers in pounds per acre

Plot No.	On Corn			On oats			On wheat			
	Acid phosphate	Muriate of potash	Nitrate of soda	Acid phosphate	Muriate of potash	Nitrate of soda	Acid phosphate	Muriate of potash	Dried blood	Nitrate of soda
31	....	....	....	....	...	....	....	....	....	....
32	80	80	80	80	80	80	160	100	25	60
33	80	80	40	80	80	40	160	100	15	30
34	....	....	....	....	....	..	....	....	....	....
35	80	40	160	80	40	160	160	50	50	120
36	80	20	160	80	20	160	160	25	50	120
37	...	....	....	....	....	....	....	....	....	....
38	....	....	....	....	....	....	100	10	*	....
39	....	....	....	....	....	....	**	....	....	....
40	...	....	....	....	....	....	....	....	....	. ..

* 7-30 tankage, 100 lbs. ** Barnyard manure, 16 tons.

TABLE XII: CROPS GROWN IN 5-YEAR ROTATION AT STRONGSVILLE

Yield and increase per acre, 1912. Total fertilizing elements for one rotation

Plot No.	Fertilizing elements: Nitrogen Lbs.	Fertilizing elements: Phosphorus Lbs.	Fertilizing elements: Potassium Lbs.	Corn: Grain Bus.	Corn: Stover Lbs.	Oats: Grain Bus.	Oats: Straw Lbs.	Wheat: Grain Bus.	Wheat: Straw Lbs.	Hay: Clover Lbs.	Hay: Timothy Lbs.	Plot No.
Yield per acre												
1	..	..	..	34.75	3,560	36.32	1,177			2,008		1
2	..	20	..	47.71	3,940	46.48	1,212			3,591		2
3	..	..	108	43.57	3,730	36.24	1,170			1,909		3
4	..	..	..	37.00	2,930	40.32	1,120			1,822		4
5	76	..	..	42.14	3,030	38.96	2,305			2,302		5
6	76	20	..	46.64	2,050	42.21	1,252			3,911		6
7	..	..	..	32.35	2,750	38.20	1,077			3,555		7
8	..	20	108	47.71	3,790	42.26	1,417			4,213		8
9	76	..	108	46.14	3,750	40.62	1,190			3,502		9
10	..	..	..	46.00	3,530	32.50	1,080			3,191		10
11	76	20	108	58.39	4,480	50.62	980			3,529		11
12	112	20	108	62.50	4,380	52.81	1,420			3,680		12
13	..	..	..	30.70	2,790	40.54	1,012			2,809		13
14	50	15	74	34.53	3,060	43.92	1,182			3,502		14
15	25	10	41	23.14	2,220	47.19	1,210			3,432		15
16	..	..	..	30.60	2,640	31.01	827			3,262		16
17	38	30	108	55.39	4,130	44.92	1,262			4,195		17
18	144	48	112	52.03	4,110	48.28	1,235			5,006		18
19	..	..	..	41.98	3,450	34.21	805			2,071		19
20	72	24	56	45 85	3,890	43.44	1,185			3,875		20
21	38	30	108	46.03	4,310	52.65	1,255			3,280		21
22	..	..	..	38.07	3,000	45.23	1,192			2.541		22
23	38	30	108	48.32	3,070	48.12	1,610			3,333		23
24	38	30	108	39.57	3,630	48.88	1,415			3,276		24
25	..	..	..	40.57	3,340	42.42	1,182			2,432		25
26	76	20	108	48.66	3,640	40.93	1,350			3,387		26
27	76	20	108	45.61	3,700	44.37	1,210			2,942		27
28	..	..	..	30.53	2,370	36.87	1,190			3,031		28
29	76	20	108	51.14	3,510	45.00	1,170			3,422		29
30	38	30	108	50.68	3,390	47.65	1,295			3,742		30
31	..	..	..	36.35	3,100	34.69	1,120			2,555		31
32	38	20	108	48.79	3,720	45.54	1,402			3,493		32
33	19	20	108	42.85	3,390	51.40	1,315			3,321		33
34	..	..	..	32.07	2,950	41.17	1,052			1,946		34
35	76	20	54	45.50	3,330	53.09	1,135			3,644		35
36	76	20	27	43.17	3,590	44.11	1,175			3,546		36
37	..	..	..	35.46	2,850	33.59	815			2,124		37
38	..	6¼	4	39.11	2,920	37.65	855			2,896		38
39	..	*	..	38.64	2,790	45.00	1,030			5,200		39
40	..	..	..	40.03	2,860	36.17	952			1,955		40
Average unfertilized yield...				36.18	3,008	37.20	1,167	Failure		2,522	Failure	
Increase per acre												
2	..	20	..	12.21	590	8.82	54			1,645		2
3	..	..	108	7.32	590	2.73	31			24		3
5	76	..	..	6.69	160	.41	47			—97		5
6	76	20	..	12.74	240	3.30	160			933		6
8	..	20	108	10.81	780	5.96	339			779		8
9	76	..	108	4.69	480	6.22	111			189		9
11	76	20	108	17.49	1,197	15.44	—77			465		11
12	112	20	108	26.69	1,343	14.95	385			743		12
14	50	15	74	3.86	320	6.55	232			542		14
15	25	10	41	—7.50	—470	13.00	310			321		15
17	38	30	108	21.00	1,220	15.37	659			1,330		17
18	144	48	112	13.84	930	15.13	422			2,538		18
20	72	24	56	5.17	590	5.55	245			1,648		20
21	38	30	108	6.66	1,160	11.09	192			895		21
23	38	30	108	9.42	57	3.82	421			828		23
24	38	30	108	—.17	—57	5.53	229			808		24
26	76	20	108	11.44	623	.36	165			755		26
27	76	20	108	11.73	1,007	5.65	22			110		27
29	76	20	108	18.67	777	8.86	3			551		29
30	38	30	108	16.27	533	12.23	157			1,026		30
32	38	20	108	13.87	670	9.55	305			1,141		32
33	19	20	108	9.35	390	12.83	935			1,171		33
35	76	20	54	12.30	513	16.12	161			1,638		35
36	76	20	27	8.84	707	8.93	281			1,481		36
38	..	6¼	4	2.13	67	3.30	—4			830		38
39	..	*	..	.13	—67	9.69	121			3,188		39

*Barnyard manure, 16 tons.

TABLE XIII: CROPS GROWN IN 5-YEAR ROTATION AT STRONGSVILLE

Average annual yield and increase per acre for the 18 years, 1894-1912

Plot No.	Fertilizing elements			Corn—18 yrs.		Oats—17 yrs.		Wheat—15 yrs.		Hay		Plot No.
	Nitrogen Lbs.	Phosphorus Lbs.	Potassium Lbs.	Grain Bus.	Stover Lbs.	Grain Bus.	Straw Lbs.	Grain Bus.	Straw Lbs.	Clover 16 yrs. Lbs.	Timothy 9 yrs. Lbs.	
Yield per acre												
1	..	..	..	22.62	1,536	33 28	1,291	5.82	650	1,621	2,290	1
2	.	20	.	31 01	1,728	42 64	1,579	13.11	1,319	2,520	2,481	2
3	..	..	108	22.93	1,629	33.55	1,273	5 92	591	1,634	1,977	3
4	..	..	..	21.67	1,483	33.25	1,197	6.76	683	1,516	2,044	4
5	76	..	..	24.71	1,642	33.99	1,239	6.54	679	1,851	2,176	5
6	76	20	..	34.95	1,797	46 01	1,736	16.87	1,646	2,580	2,585	6
7	..	..	..	26.54	1,687	34 94	1,353	6.85	719	1,949	2,215	7
8	..	20	108	36.30	1,989	45.80	1,832	15.63	1,391	2,607	2,751	8
9	76	..	108	29.21	1,836	39.51	1,584	9.61	990	2,168	2,406	9
10	..	..	..	26.94	1,691	37.53	1,445	8 61	831	1,913	2,459	10
11	76	20	108	38.50	2,163	50.52	1,978	18.45	1,814	2,790	2,956	11
12	112	20	108	39.45	2,170	50.24	1,877	20 73	2,042	2,724	2,780	12
13	..	..	..	26.41	1,701	37.82	1,463	8.34	838	1,930	2,439	13
14	50	15	74	35.16	2,062	41.57	1,584	18.65	1,815	2,728	2,748	14
15	25	10	41	28 46	1,724	37.02	1,428	17 07	1,645	2,520	2,515	15
16	..	..	..	38.38	1,730	34.94	1,322	8 55	795	1,969	2,362	16
17	38	30	108	38.57	2,140	49.54	1,889	17.07	1,561	2,854	2,802	17
18	144	48	112	40 06	2,257	43 11	1,697	16.41	1,662	2,883	2,913	18
19	..	..	..	25.66	1,759	35.35	1,301	6.84	662	1,918	2,379	19
20	72	24	56	34.26	2,064	41.01	1,626	12.75	1,298	2,706	2,802	20
21	38	30	108	36.27	2,187	50.89	2,077	18.05	1,750	2,843	2,880	21
22	..	..	..	27.65	1,817	39.63	1,612	9 03	887	2,192	2,421	22
23	38	30	108	48.20	2,153	51.47	2,170	17.73	1,732	2,844	2,950	23
24	38	30	108	36.92	2,203	51 50	2,145	18.18	1,756	2,839	2,890	24
25	..	..	..	27.34	1,838	37.63	1,517	8.21	815	1,974	2,348	25
26	76	20	108	35 97	2,169	48.66	1,906	18.85	1,766	2,920	2,760	26
27	76	20	108	34.70	2,109	48.61	1,900	17.70	1,709	2,595	2,389	27
28	..	..	..	24.94	1,709	35 40	1,300	8.34	817	1,837	2,161	28
29	76	20	108	36.46	2,111	47 00	1,797	18.69	1,795	2,679	2,605	29
30	38	30	108	41.64	2,204	48.56	1,798	18.60	1,741	2,972	2,893	30
31	..	..	..	25.42	1,721	34.32	1,237	7.81	757	1,822	2,210	31
32	38	20	108	34.47	2,082	46.79	1,830	16.81	1,585	2,718	2,553	32
33	19	20	108	34.66	2,056	46.11	1,803	15.75	1,455	2,724	2,617	33
34	..	..	..	23.89	1,682	33.38	1,302	7.33	728	1,740	2,090	34
35	76	20	54	34.48	2,025	47.40	1,961	17.46	1,677	2,737	2,535	35
36	76	20	27	36 43	2,136	45.65	1,834	17.67	1,649	2,872	2,555	36
37	..	..	..	26.51	1,712	34.28	1,362	6.80	671	1,989	2,076	37
38	..	6¼	4	30.82	1,900	35.51	1 413	15.15	1,440	2,620	2,580	38
39	..	*	..	30.90	1,855	35.61	1,424	14.30	1,476	2,9b1	2,816	39
40	..	..	..	24.34	1,645	31.89	1,229	6 60	654	1,790	2,067	40
Average unfertilized yield...				26.15	1,761	35.24	1,367	7.57	752	1,899	2,254	
Increase per acre												
2	..	20	..	8.70	210	9.38	319	6 98	654	934	273	2
3	..	..	108	.95	128	.61	46	—.53	—82	83	—149	3
5	76	..	..	1.41	91	.25	40	—.26	—16	191	75	5
6	76	20	..	10.04	233	11.64	436	10.05	939	775	427	6
8	..	20	108	9.63	301	10.00	448	8.19	635	670	455	8
9	76	..	108	2.40	145	2.84	169	1.57	197	243	29	9
11	76	20	108	11.73	469	12.92	527	9.93	981	870	504	11
12	112	20	108	11.76	472	12.59	436	12.30	1,206	799	335	12
14	50	15	74	8.35	351	4.79	168	10.24	991	785	335	14
15	25	10	41	1.48	4	1.38	71	8.60	835	564	128	15
17	38	30	108	11.85	400	14.61	587	9.10	811	902	434	17
18	144	48	112	13.87	513	7.89	389	9.01	955	947	540	18
20	72	24	56	7.82	286	4.09	221	5.18	561	697	409	20
21	38	30	108	9 28	379	12.69	569	9.75	938	744	473	21
23	38	30	108	10.65	335	12.51	589	8.97	868	724	553	23
24	38	30	108	9.47	347	13.20	596	9.69	917	793	518	24
26	76	20	108	9.43	374	11.19	461	10 30	951	991	475	26
27	76	20	108	8.95	357	12 47	527	9 40	893	713	166	27
29	76	20	108	11.28	392	11.97	479	10.53	998	847	428	29
30	38	30	108	16.44	488	13.87	463	10 61	964	1,144	700	30
32	38	20	108	10.40	407	12.83	493	9.17	838	923	383	32
33	19	20	108	10.68	377	12.44	525	8 26	718	956	487	33
35	76	20	54	9.72	339	13 81	579	10.31	968	914	450	35
36	76	20	27	10.80	434	11.71	492	10.69	959	966	474	36
38	..	6¼	4	5.03	210	2.02	94	8.42	775	698	507	38
39	..	*	..	5.83	188	2.94	150	7.64	814	1,095	746	39

*Barnyard manure, 16 tons per acre.

TABLE XIV. TOTAL FERTILIZING MATERIALS AND THEIR COST AND TOTAL NET VALUE OF INCREASE PRODUCED FOR 5-YEAR PERIODS AND FOR 18-YEARS ALL CALCULATED FOR ONE ROTATION OF 5 YEARS AT STRONGSVILLE

Plot No.	Fertilizing materials in pounds per acre for each rotation	Cost of fertilizers for each rotation	Average value of total increase per acre for each rotation				Net gain or loss (—) from fertilizers for each rotation				Plot No.
			First 5-years	Second 5-years	Third 5-years	18-year average Total	First 5-years	Second 5-years	Third 5-years	18-year average Net	
2	Acid phosphate, 320	$ 2.60	$14.10	$21.66	$16.04	$17.71	$11.50	$19.06	$13 44	$15.11	2
3	Muriate potash, 260	6.50	.70	.92	—1.25	—.19	—5 80	—5.58	—7.75	—6.69	3
5	Nitrate soda, 44; dried blood, 50	14.40	.77	.77	2.48	1.46	—13.63	—13.63	—11.92	—12 93	5
6	Acid phosphate, 320; nitrate soda, 440; dried blood, 50	17.00	18.13	24.68	22.22	22.37	1.13	7.68	5.22	5.37	6
8	Acid phosphate, 320; muriate potash, 260	9.10	16.47	19.77	21.10	19.41	7.37	10 67	10.00	10.31	8
9	Muriate potash, 260; nitrate soda, 440; dried blood, 50	20.90	3.36	2.90	13.58	4.46	—16.54	—18.00	—7 32	—16.44	9
11	Acid phos., 320; mur. potash, 260; nitrate soda, 440; dried blood, 50	23.50	21.79	24.69	23.71	24 19	—1.71	1.19	.21	.69	11
12	" " 320; " " 260; " " 680; " " 50	30.70	22.33	26.57	24.22	24 92	—8 37	—4.13	—6 48	—5.78	12
14	" " 240; " " 180; " " 280; " " 50	16.05	18.71	19.43	18.39	19.38	2.66	3.38	2.34	3.33	14
15	" " 160; " " 100; " " 120; " " 50	8.60	9.91	13.46	14.24	11.44	1.31	4.86	5.64	2.84	15
17	" " 480; " " 260; " " 220; " " 25	17.60	13.91	28.58	25 26	23.14	—3.69	10.98	7.66	5.54	17
18	Yard manure, 16 tons	?	16.65	20.16	25.16	22.52	?	?	?	?	18
20	Yard manure, 8 tons	?	12.56	12.62	21.22	13 76	?	?	?	?	20
21	Same elements as 17, but nitrogen in oilmeal	17.60	18.51	25.05	20.77	22.68	.91	7.45	3.17	5.08	21
23	" " " 17, " " " dried blood	17.60	20 54	24.14	20.63	22.46	2.94	6.54	3.03	4.86	23
24	" " " 17, " " " sulphate ammonia	17.60	20.46	24.93	21.71	23.15	2.86	7.33	4.11	5.55	24
26	" " " 11, " phosphorus in bonemeal	23.50	20.44	26 02	21.59	23.77	—3.06	2.52	—1.91	.27	26
27	" " " 11, " " " dissolved boneblack	23.50	17.34	24.03	21.22	20.68	—6.16	.53	—2.28	—2.82	27
29	" " " 11, " " " basic slag	23.50	23.19	25.52	21.22	23.90	—.31	2.02	—2.28	.40	29
30	" " " 17, " nitrogen in tankage	17.60	24.91	35.55	25.39	29.34	7.31	17.95	7.79	11.74	30
32	Acid phos., 320; mur. potash, 260; nitrate soda, 220; dried blood, 25	19.90	20.98	24.38	20.59	22.72	1.08	4.48	.69	2.82	32
33	" " 320 " " 260; " " 110 " " 15	14.50	20.91	24 53	18 71	22.13	6.41	10.03	4.21	7.63	33
35	" " 320 " " 130; " " 440 " " 50	27.45	20.36	23 98	23.96	23.56	—7.09	—3.47	—3.49	—3.89	35
36	" " 320 " " 65; " " 440 " " 50	25.62	22.14	26.81	21.37	24.27	—3.48	1.19	—4.25	—1.35	36
38	" " 100 " " 10; tankage (7-30) 100	?	*12.23	20.38	13.68	13.49	?	?	?	?	38
39	Yard manure, 16 tons	?	*8.38	14.73	22.70	17.08	?	?	?	?	39

The nearest practicable approach to a common denominator for the various kinds of produce grown in this rotation is their market value, and in Table XIV the results of the test are arranged on this basis for three 5-year periods and for the entire 18 years, corn being rated at 40 cents per bushel, oats at 30 cents, wheat at 80 cents, hay at $8.00 per ton, stover at $3.00 and straw at $2.00; valuations much below present prices for the grains, but not far from the average during the period of the test.

The fertilizing materials are valued at a fraction over $16.00 per ton for acid phosphate, 2½ cents per pound for muriate of potash and 3 cents per pound for nitrate of soda; and it is assumed that the cost per pound of the fertilizing elements will be practically the same in the other carriers used on Plots 21 to 39, inclusive.

The table shows a decidedly greater increase from the fertilizers during the second period than during the first, but in most cases there has been a retrograde movement during the third period, except on the manured plots, where the largest increase is found in the the third period.

Taking the average results for the entire period it will be seen that the effect of acid phosphate, used alone, has been greater at Strongsville than at Wooster, while that from tne carriers of nitrogen and potassium has been smaller, and although these carriers have added to the total value of the increase when used in combination with carriers of phosphorus they have not added enough to compensate the increased cost of the fertilizer. During the first 10 years of the test Plot 30 received a larger application of phosphorus than any other one in the series.